Amateur Radio Data Compression Controversies

An attempt to summarize hundreds of FCC filings objectively

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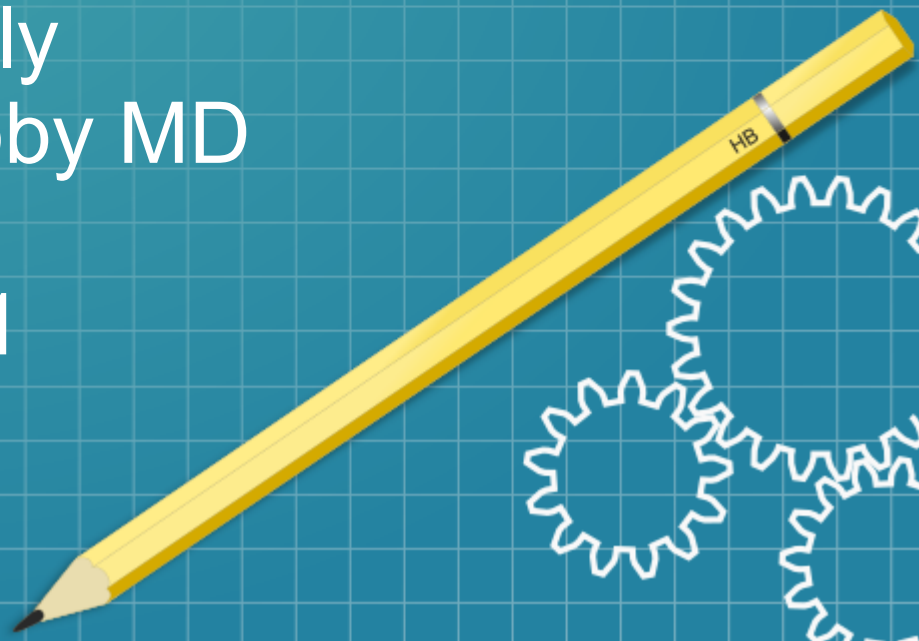
NCS521



My apologies

- There is more than I can hope to cover in 50 minutes.
- I performed about 7 original studies, wrote the first software to spy on WINLINK. Banned by QRZ after administrator interference.
- Submitted > 400 pages
- > 500 footnotes
- Here we go!

Questions are Welcome

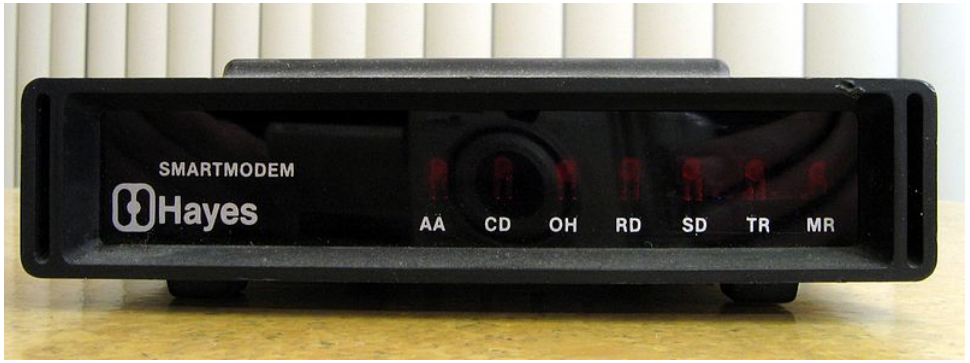
- This can be complicated stuff.
- If you have a question, don’t hesitate to ask!

Early amateur radio

- CW -- on/off keying of every imaginable alternator, spark generator, oscillator.....
- Voice -- amplitude modulation of the carrier in any way possible....carbon mic, plate modulation.....
- Unbelievably: First SSB

Telephone.....Data

- AT&T prevented connection of ANYTHING to their telephone network....1956/1968 court decisions allowed innovation
- With invention of personal computer, audible tones used in acoustic couplers to telephone handsets to send and receive characters
- Bell 103 modem 300 baud, AFSK 1962
- Bell 202 audio frequency shift keying 1976, 1200 baud.
- “MODEM”
- Hayes “smartmodem”
- 1200 Baud 1985.



Michael Pereckas from Milwaukee, WI, USA [CC BY-SA (https://creativecommons.org/licenses/by-sa/2.0)]

Telephone BBS

- Forerunner of the Internet
- Personal computers, telephones, modems: messages to group or between members
- File sharing
- https://en.wikipedia.org/wiki/Bulletin_board_system
- Commercial systems (“AOL”) and private systems -- “CBBS” went online 1978. Hundreds of thousands of connections.

Ham Radio Meets Data

- CW -- first digital technique 1/0
- Terry Fox WB4JFI 1984 publishes ver. 2.0 of AX.25 protocol. Packets of both “unconnected” and “connected” types (similar to UDP versus TCP on Internet)
- “Connected” is error-free: ARQ corrects errors (“electronic fills”)
- Eric Scace K3NA -- major update 7th Computer Networking Conference 1988
- Protocol: http://www.ax25.net/AX25.2.2-Jul%2098-2.pdf

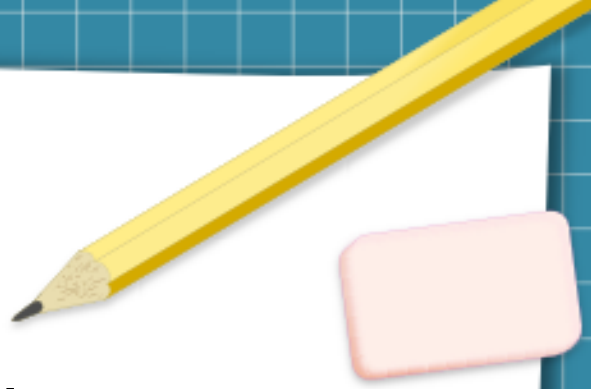
Flag	Address	Control	Info	FCS	Flag
01111110	112/224 Bits	8/16 Bits	N*8 Bits	16 Bits	01111110

Figure 3.1a U And S Frame Construction.

Flag	Address	Control	PID	Info	FCS	Flag
01111110	112/224 Bits	8/16 Bits	8 Bits	N*8 Bits	16 Bits	01111110

Figure 3.1b Information Frame Construction.

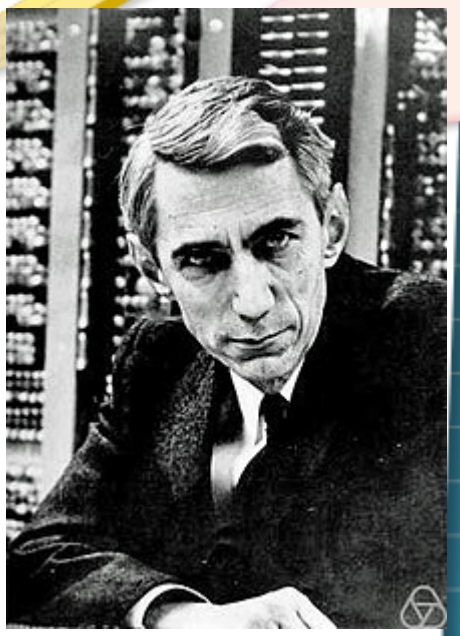
Compression



- Hard Drives are measured in Megabytes
- Digital compression algorithms are BIG NEWS
- **Lawsuits**
- Big money involved....
- Various types of compression
  - static tables (scan entire file, build table)
  - dynamic (build table as go along)

Mathematicians

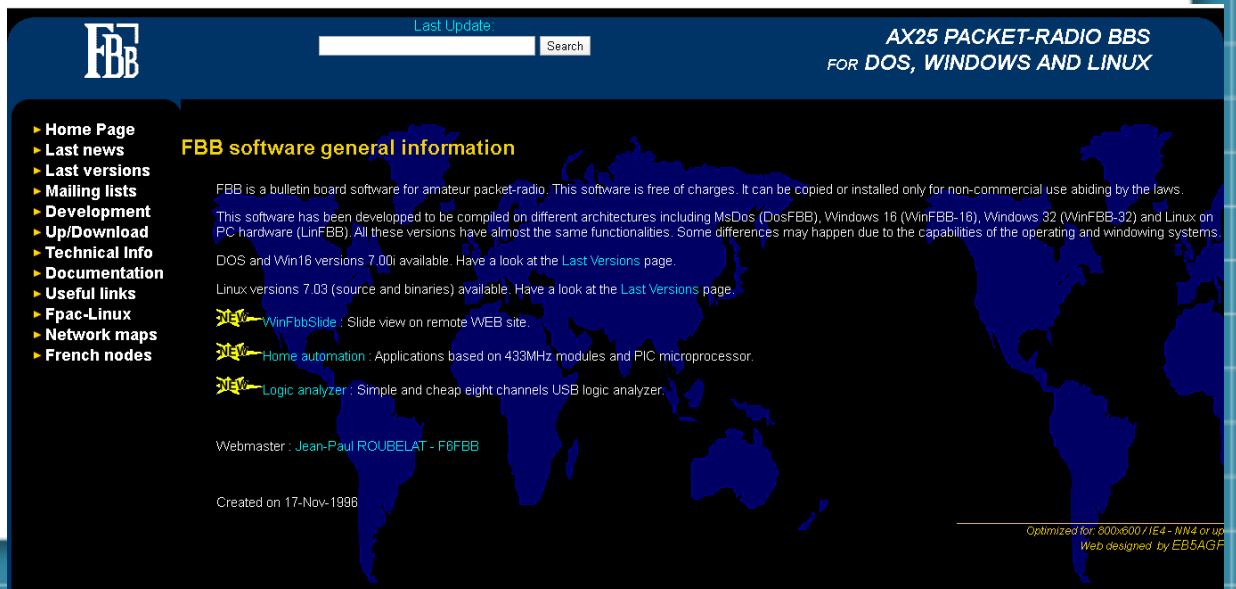
- Shannon/Faso 1949: Claude Shannon, Robert Fano assign shorter codes to most-frequently occuring symbols, compressing text. (Yes, this is THE Shannon.....)
- 1951: Their student David Huffman works to avoid having to take their final exam: writes paper with ground-up probability-based compression superior to that of his professors “Huffman Tables” are born.
-



Claude Shannon https://commons.wikimedia.org/wiki/File:ClaudeShannon_MFO3807.jpg

France, 1986

- Way before the Web, or SmartPhones
- **Jean-Paul Roubelat** F6FBB begins to develop Bulletin Board Systems on amateur radio
- Users can message each other, send bulletins or data files....
- ? VHF ? HF
- AX.25



1971-1999

Index of /pub/hamradio/f6fbb/distrib/linux/

[parent directory]

Name	Size	Date Modified
alpha/		4/27/03, 8:00:00 PM
packages/		9/19/02, 8:00:00 PM
patch_700g_y2k.tgz	1.2 kB	1/11/00, 7:00:00 PM
pciscc/		4/26/03, 8:00:00 PM
src/		9/7/03, 8:00:00 PM
tools/		4/26/03, 8:00:00 PM
x700b27.tgz	1.1 MB	4/16/99, 8:00:00 PM
x700b28.tgz	1.1 MB	4/16/99, 8:00:00 PM
x700b29.tgz	1.1 MB	4/16/99, 8:00:00 PM
x700b30.tgz	1.2 MB	4/16/99, 8:00:00 PM
x700b36.tgz	881 kB	4/16/99, 8:00:00 PM
x700b39.tgz	902 kB	4/16/99, 8:00:00 PM
x700b40.tgz	902 kB	4/16/99, 8:00:00 PM
x700b41.tgz	902 kB	4/16/99, 8:00:00 PM
x700b45.tgz	906 kB	4/16/99, 8:00:00 PM
x700c.tgz	904 kB	4/16/99, 8:00:00 PM
x700c07.tgz	767 kB	4/16/99, 8:00:00 PM
x700c08.tgz	767 kB	4/16/99, 8:00:00 PM
x700c09.tgz	778 kB	4/16/99, 8:00:00 PM
x700c10.tgz	778 kB	4/16/99, 8:00:00 PM
x700d.tgz	1.0 MB	4/16/99, 8:00:00 PM
x700e.tgz	1.0 MB	4/16/99, 8:00:00 PM
x700e03.tgz	1.0 MB	4/16/99, 8:00:00 PM
x700e_full.tgz	1.7 MB	4/16/99, 8:00:00 PM
x700f01.tgz	1.0 MB	4/16/99, 8:00:00 PM

- Abraham Lempel, Jacob Ziv create LZ77 using software-created dictionary.
- Japanese Doctor (MD) created LZHUFF -- a dynamic compression algorithm **free of legal risk.**
- Jean-Paul Roubelat F6FBB incorporated LZHUFF in his newly-created protocols for radio passage of binary or other files in his FBB bulletin board system.
- Extant free source is still available from 1999; usage now known even earlier.

Tiny Explanation of LZHUF

- Windowing or streaming compression -- doesn't have to have the entire text in order to begin creating output.....
- But traditional implementations failed to take advantage of that.
- Adds extra bits to send to indicate tabular entries of compressed items -- possibly offsets from previous....its complicated.
- As long as you are in sync -- works fine.
- Lose sync -- and your output becomes increasingly garbled from then on.
- Public domain.

FBB Protocols
Step 1: declare station capability

- Computer-to-Computer understanding of protocols available:
  - AuthorString, Version#, Features Available

FBB-7.00-AB1FHMX$

means....

FBB protocols in use

Version 7.00

Capabilities AB1FHMX$ (see next slide)

How to read the capabilities

- **Capabilities AB1FHMX$ -- unpacking:**

  A: acknowledge for personal messages

  B: FBB compressed protocol V0 is supported

  B1: FBB compressed protocol V1 is supported

  F: FBB basic protocol supported

  H: Hierarchical location designators supported

  M: Message identifier supported

  X: Compressed batch forwarding supported

  $: BID supported (must be last character of the list)

FBB Protocols
Step 2: Post message

- Computer-to-Computer submission of a file transfer proposal:
- **FB P FC1CDC F6ABJ 24754_F6FBB 345**
- **MEANS:**
  - **FB protocol**
  - **an email to a person “private” in parlance**
  - **Sender field**
  - **BBS of the recipient**
  - **“BID ou MID” (unknown French)**
  - **Size of message in bytes (345 bytes)**

FBB Protocols
Step 3: send message

- Compressed ASCII protocol:

  Format of the ASCII compressed message: (type FA)

  <SOH> (start of header) 1 byte = **01 Hex**

  Length of header 1 byte = Length of title and offset, including the two NUL characters

  <NUL> 1 byte = **00 Hex**

  Offset 1 to 6 ASCII bytes

  <NUL> 1 byte = **00 Hex**

- Binary FB transmission format:

  <SOH> (start of header) 1 byte = 01 Hex

  Length of the header 1 byte = length of filename and offset including the 2 NUL characters

  Name of the file (1 to 80 ASCII bytes)

  <NUL> 1 byte = 00 Hex

  Offset 1 to 6 ASCII bytes

  <NUL> 1 byte = 00 Hex

Data Block Segment

Data Block format, of 1 to 256 bytes:

<STX> (start of data block) 1 byte = **02 hexadecimal**

Size of data 1 byte = 00 to ff hex; 00 indicating 256 bytes

Data bytes, 1 to 256 bytes

The final data block is followed by the end of file specifier and the checksum:

<EOT> 1 byte = **04 hexadecimal**

Checksum: 1 byte = 00 to ff hexadecimal

My paper on this:

- August 8 2019 submission to the FCC
- https://ecfsapi.fcc.gov/file/10808597817982/ExParteCommunicationAug8.pdf
-
- Pretty simple, straightforward protocol, right?
- Who would have ever thought this would be later called a national security threat.

Still works!

- There are likely FBB bulletin boards STILL working around the world!
- *All using LZHUFF dynamic compression*
- Works on any AX.25 connection.
- VHF -- use 1200 AFSK (AX.25)
- HF -- use 300 Baud AFSK (AX.25) -- still in use!
- (Other work was widely done on AMTOR, G-TOR, PACTOR back 20-odd years ago....)

Digital *auto* moves to HF

- Up until this dramatic 1995 FCC move, only humans could communicate on HF in the United States.

April 1995

- FCC allows automatically controlled stations on HF with two important limitations
-
  - *auto* to *auto* limited to 97.221(b) sub bands
  - human to auto elsewhere, but <500Hz (97.221c)
  - https://apps.fcc.gov/edocs_public/attachmatch/FCC-95-163A1.pdf

6. We do recognize the concerns of those who oppose the proposal on the basis of potential interference, and in response to these concerns we are limiting when automatic control can be employed. **First, the control operator of the station that is connected to the automatically controlled station must prevent the automatically controlled station from causing interference. Second, we are designating sub bands to which transmissions between two automatically controlled stations are confined.** These sub bands are a small portion of the spectrum otherwise available for digi tal emission types. We also are confident in the ability of the amateur service community to respond, as it has in the past, to the challenge of minimizing interference with nov el technical and operational approaches to the use of shared frequency bands.

7. Requiring automatically controlled stations to transmit only in the designated subbands when communicating with another automatically controlled station, furthermore, will not reduce the HF spectrum available for other emission types. The bandwidth of the transmissions of an automati cally controlled station will occupy no more than 500 Hz, and the subbands represent only 3.8 percent of the HF spectrum authorized to the amateur service. Other than Morse telegraphy, 15 only digital emission types are cur rently authorized for the specified subbands. Nothing in the rules that we are adopting prohibits other stations from continuing to share these subbands. 16

97.221(c)

97.221(b)

WINLINK (ca. 1995+)

- Developers of WINLINK reused Jean-Paul's publicly documented protocols liberally
- Added in a new FC protocol
- Adopted his **compression algorithms** completely
- Allowed for PACTOR HF connections (and possibly others?)
- Natural user base: **BOATERS AT SEA**
- By this time, NTS was having problems, as Cell Phone / Email was badly eating into desire for Radiograms...

Volunteer development

- Winlink grew in capabilities and usage for quite a while. (Peak HF usage in the mid 2000 decade)
- Developed far cheaper soundcard modes
  - WINMOR
  - ARDOP

    Continued to use the same exact compression for all those years.

Systems using LZHUF

- FBB
- D-RATS
- WINLINK
- PAT (open source portable version of winlink)
- BPQ

2001

- Twin Towers -- and the development of Incident Command System (from California fire fighters) and new “interoperability” (after deaths of firefighters & others)

2002

2003

2004

2005

- Hurricane Katrina reveals the sad state of national reponse to massive disasters
- Massive communications loss.
- Hams are very instrumental.

2006

- (Before my time)
- Mark Miller N5RFX petitions to limit automatic stations of any bandwidth to the 97.221(b) spaces, complaining of interference, outlaw Pactor III [https://ecfsapi.fcc.gov/file/6519008574.pdf
- RM-11392. 666 comments....pretty heated
- FCC denied his petition. http://www.arrl.org/news/fcc-denies-two-amateur-radio-em-petitions-for-rulemaking-em

2007

2008

2009

2010

2011

2012

2013

ARRL petitions (RM-11708) to remove the “baud rate” limitations on digital modes.

2014

2015

2016

- Ted Rappaport PhD begins to express concerns to the FCC that WINLINK is effectively encrypted and can be used by Terrorists.
- FCC issues Notice of Proposed Rulemaking (16-239) proposing to remove 300-baud limit...igniting a firestorm by not having any bandwidth limit.
- (see: https://ecfsapi.fcc.gov/file/0728122180423/FCC-16-96A1.pdf)

Rappaport Example: 2016

"I pointed out national security concerns with the current problem of **encrypted data**, which arises from the non published compression algorithms used in Pactor II, Pactor III, and Pactor IV, and also discussed how the identification of many ACDS stations are often **encrypted**, as well, since that is an option on the SCS modems." [emphases added]
Ref: Rappaport, https://ecfsapi.fcc.gov/file/111024120391 0/Reply%20to%20Comments%20NPRM.docx

Completely fallacious. Nothing is encrypted.

~2017

- WINLINK develops improved “radio-only” forwarding that works in the event of complete shutdown of Internet
- Federal Government uses WINLINK for SHARES

Rappaport: 2018

"….where many commenters stated the precise technical arguments about interference, the numerous FCC rules violations by ACDS transmissions, the improper use of amateur radio conducted over email and internet, and the need for documented coding (e.g. avoidance of **encryption through the use of open and published compression algorithms**). "

Of course: the compression in winlink had been published for more than 30 years.....

Reference: Rappaport, https://ecfsapi.fcc.gov/file/1022117362165/FCC%20PS%2017-344%20Reply%20to%20ARRL%20and%20Steve%20Waterman%20from%20N9NB.pdf

In paragraph 23 of this Document, Dr. Rappaport discusses at great length facilities of the SCS modems, which are disabled by WINLINK software, but appears unaware of that fact.

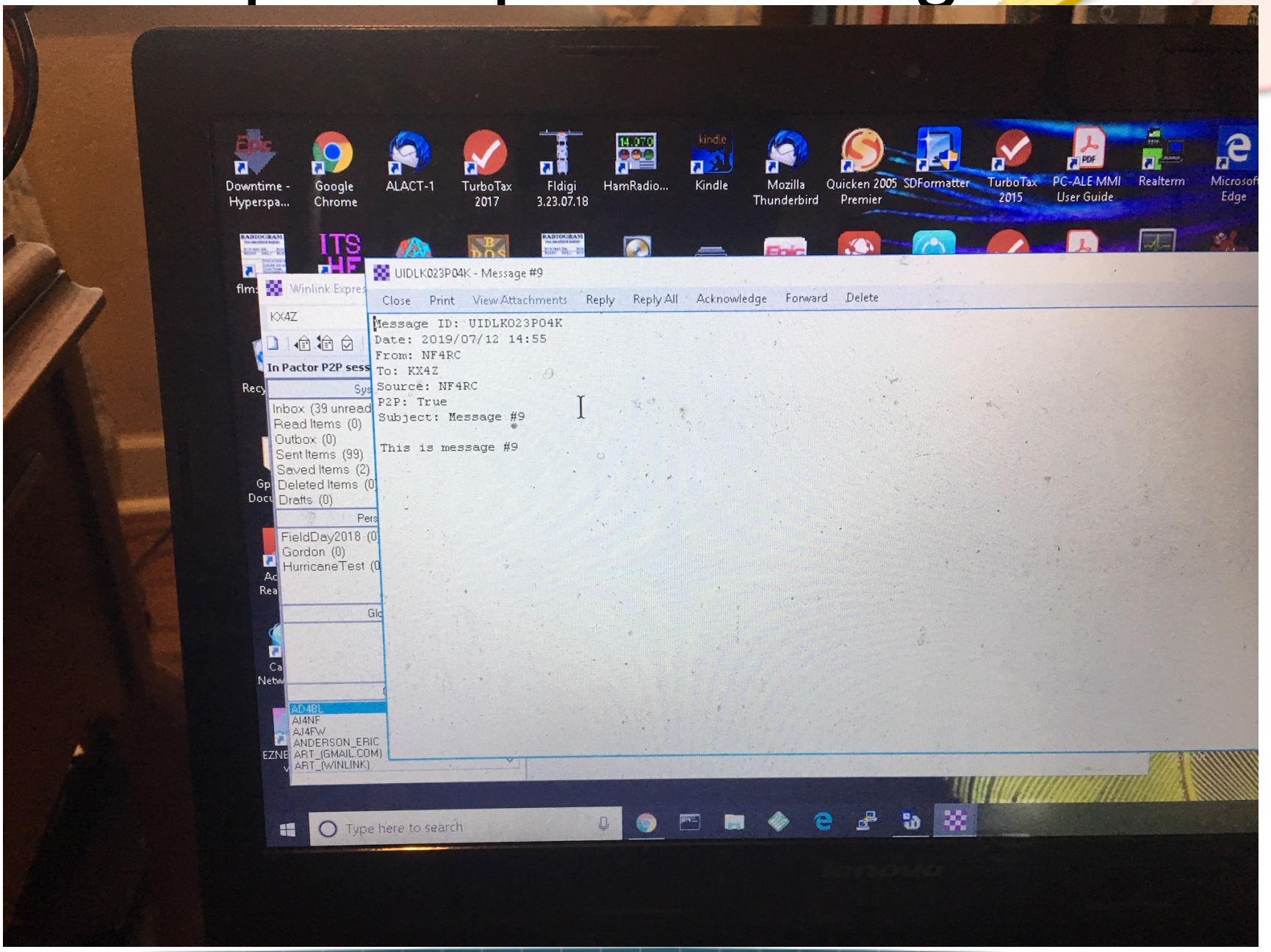
Ron Kolarik's Petition

- RM-11831
- claims problematic interference from 500Hz stations
- forbid any digital that can't be done by free source code (outlaw intellectual property)
- Rappaport intensifies claims of "encryption"

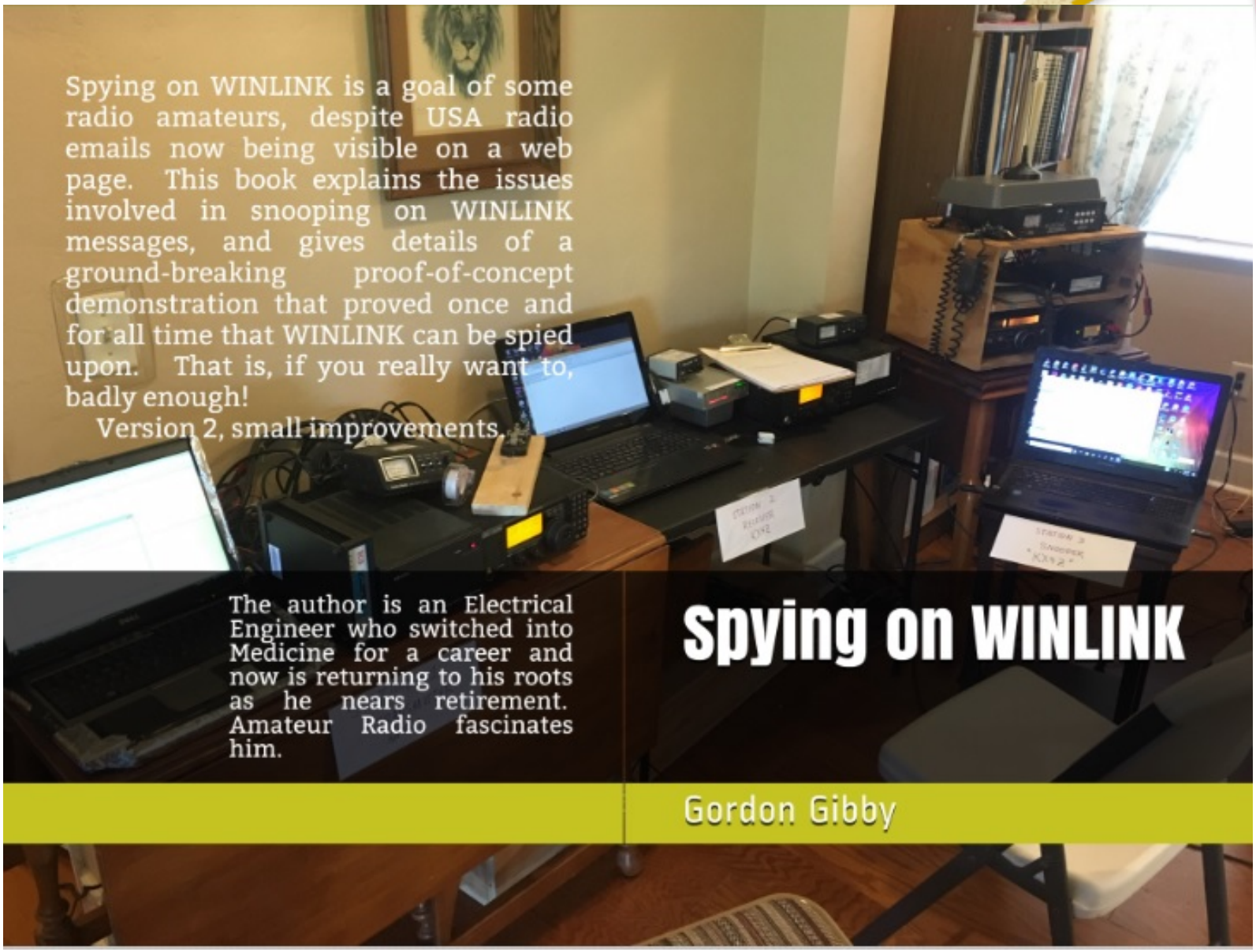
Kludgey Experiment: disprove encryption

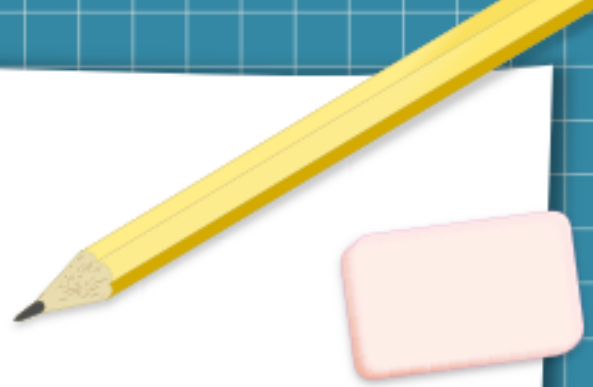
- Statistically finite chance to simply monitor small transmissions using ordinary WINLINK software and read the same message
- Requires real receiving station to issue ACK's
- Requires fake receiving station to THINK it is issuing ACK's -- simply disable its transmitter
- SUCCESS!
- Not easy to pull off, but we did it multiple times
- Completely disproves encryption.

Spied Upon Message



Published on Amazon





- This experiment was completely explained and its very limited applicability completely explained.
- Nevertheless it was misinterpreted....
- Months of useless arguing ensue.
- False statements even about LZHUF abound...disproved with simple desktop experiments since sofware widely available.

Illegal?

Actually the ITU-R reworded regs to explicitly MAKE THESE TECHNIQUES PATENTLY LEGAL -- and even sponsored multiple WINLINK stations for emergency communications in the Gulf and now the Caribbean.

3rd Party Traffic

- Learning point for me!
- MOST email = 3rd part traffic.
- DON'T CONNECT TO EUROPEAN RMS SERVERS!
- Winlink software added provisions to deal with this. (I haven't tested)

97.221(c) WINLINK spectrum-time

TWO WEEK STUDY
14 Days, 24 hours per day, 60 minutes per hour =20,160 minutes
Typical Data band has 100 kHz space available (study used exact numbers)
97.221(c) is only 1/2 kilohertz

BAND	Total kHz Avail	Total USA 97.221(c) stations	Total minutes used	% of spectrum time
40 m	75	24	372	0.012%
20 m	69.9	9	9	0.000319%

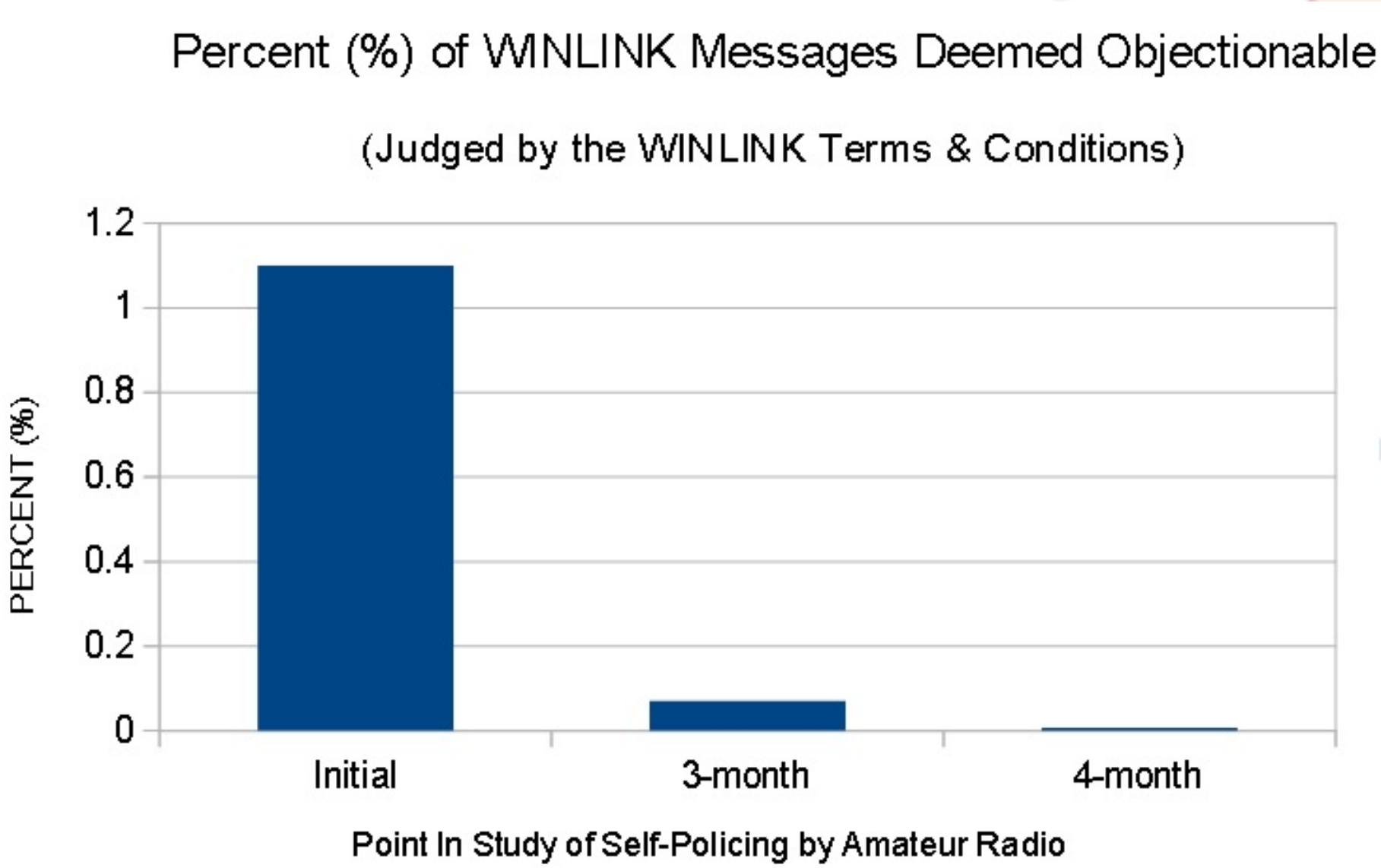
REFERENCE: https://ecfsapi.fcc.gov/file/10408063816674/FCCRM11831-2.pdf

WINLINK introduces “viewer”

- Apparently felt forced to prove lack of privacy.
- Detractors immediately compile list to send to enforcement bureau (which still hasn’t done anything)
- Europeans complain of privacy violations.
- Reporting button allows reporting (items are then moved off and handled by Tom N5TW)
- Detractors then complain things are “hidden”
- Detractors then complain its is a violation of other laws to present anything.

Gold Mine for analysis

- I estimated the INCIDENCE of objectionable information.
- Detractors who had made the referral gave me only very very limited information, then later complained I didn't have the right information.
- Obviously, did the best I could with what people gave me.


Percent (%) of WINLINK Messages Deemed Objectionable
(Judged by the WINLINK Terms & Conditions)
PERCENT (%)
1.2
1
0.8
0.6
0.4
0.2
0
Initial
3-month
4-month
Point In Study of Self-Policing by Amateur Radio

Stunning Self Policing

- There is nothing like it in all else of amateur radio.
- Nothing even documented....
- Much less reduced by two orders of magnitude

Enter: John S. Huggins KX4O

- Linux hobbyist.
- Captured reams of pactor transactions on a single frequency.
- Used **cut-and-paste techniques** to try and de-compress using publicly available algorithm
- Amazingly, got a large portion of a message decompressed -- even tho he didn't understand the embedded packet-delimiters

Huggin's Mistake

- *Didn't understand the packet delimiters*
- I sent him the information and he improved his technique.

Huggin's Perfect Copy

MID: 2YVAFEECIB8J
Date: 2019/07/29 16:29
Type: Private
From: KM4HRR
To: KW4SHP
Subject: Re: //WL2K My second Winlink email
Mbo: KM4HRR
Body: 748

Fanatstic! Awesome stuff. Look slike it's working justr fine. Congrats!!!

73,
Brendan KM4HR

----- Message from KW4SHP sent 2019/07/28 23:41 -----

Message ID: FO40YS492PHY
Date: 2019/07/28 23:41
From: KW4SHP
To: KM4HRR
Source: KW4SHP
Subject: //WL2K My second Winlink email

Brendan:

Just completed my Winlink HT setup.

Request for Programmers

- Huggins requested programmers to help.
- IRONY: Rappaport is a Dept. Chairman -- and listed as part of Computer Science at his University.
- IRONY: >30,000 computer hobbyists in NYC
- NO ONE VOLUNTEERED
- So I found my decades-old C-coding text (K&R) and started to relearn how to code on a Raspberry pi (because it had a free compiler)

Could NOT read the Pactor

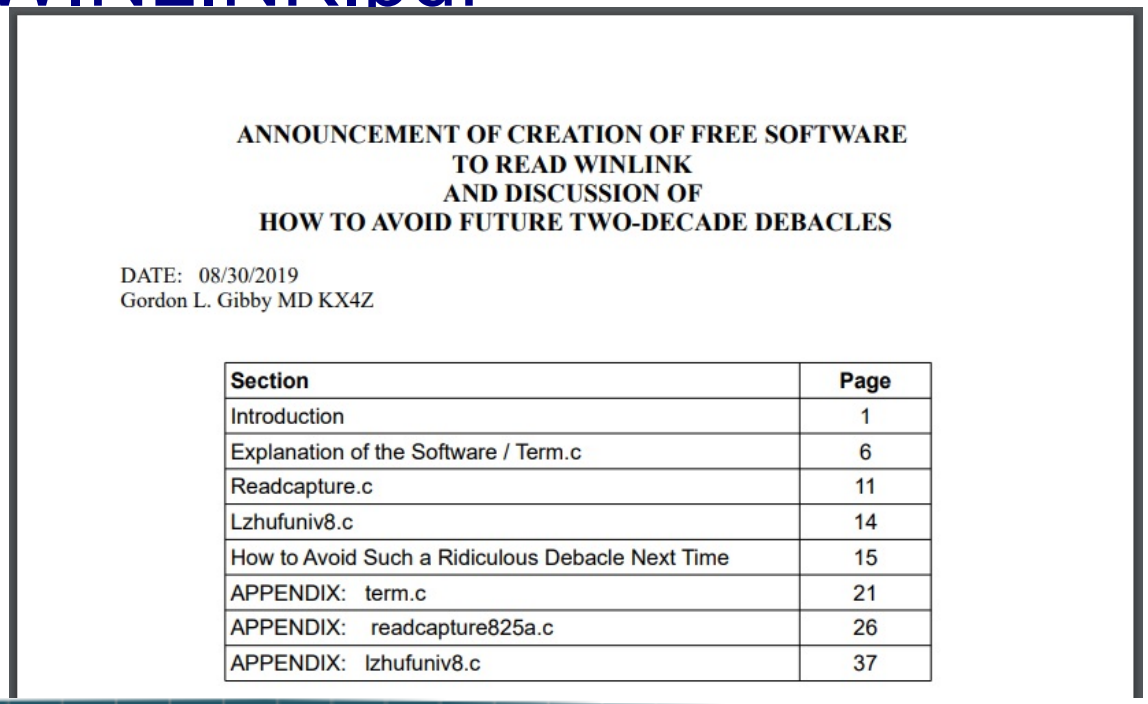
- 20 days wasted trying to read the serial port
- Suddenly: Peter Helfert sends C-code
- Wrong baud rate.
- Fixed that.
- Instant success: I can read the pactor output

Five Day of Programmer Hell

- Five days of writing code on a PC
- printf() statements EVERYWHERE to help diagnosis (don’t understand debuggers)
- Email it to the raspberry
- Compile it and run on the raspberry
- Spend an hour trying to figure out the crash
- Back to the PC

8PM Sunday Night

- SUCCESS!!
- I can decompress a pactor winlink message
- Published to the FCC shortly thereafter
- https://ecfsapi.fcc.gov/file/10830048730238/FreeSoftwareToReadWINLINK.pdf



ANNOUNCEMENT OF CREATION OF FREE SOFTWARE TO READ WINLINK AND DISCUSSION OF HOW TO AVOID FUTURE TWO-DECADE DEBACLES

DATE: 08/30/2019
Gordon L. Gibby MD KX4Z

Section	Page
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Lzhufuniv8.c	14
How to Avoid Such a Ridiculous Debacle Next Time	15
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August 30 2019

ANNOUNCEMENT OF CREATION OF FREE SOFTWARE TO READ WINLINK AND DISCUSSION OF HOW TO AVOID FUTURE TWO-DECADE DEBACLES

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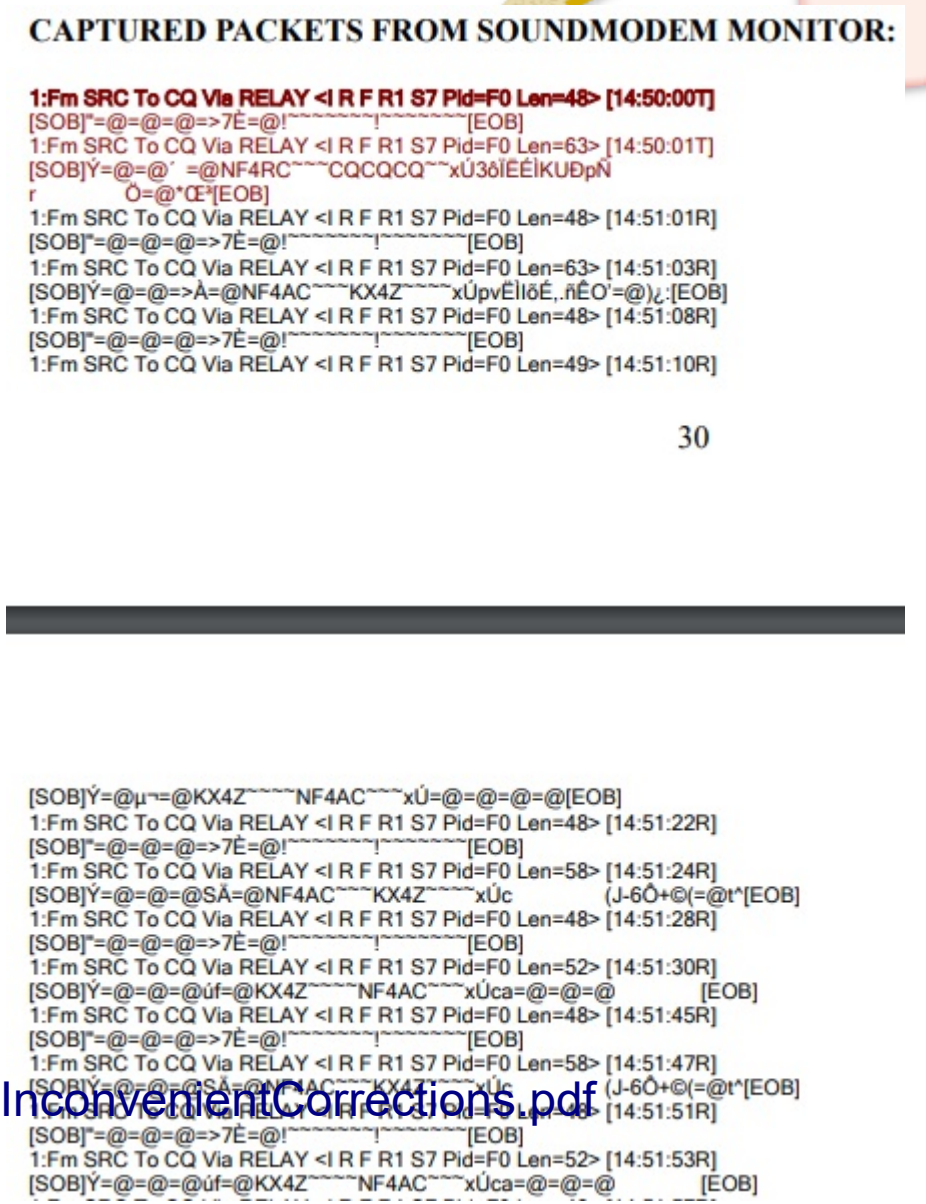
Multiple Improvements

- Various bugs and poor programming were corrected over next weeks.
- Peter Helfert then produced a version that ran on a Windows PC -- huge improvement
- Peter later rewrote the decompression so that it was REAL-TIME
- I decoded many WINLINK messages
- To my knowledge, this was NEVER TRIED by any of the detractors.

D-RATS CHALLENGE

- contrary to their claims, MULTIPLE systems use LZHUF and have no method for surveillance
- Challenge to read D-RATS
- Challenge to read FLMSG (compressed)
- Never done to my knowledge.



CAPTURED PACKETS FROM SOUNDMODEM MONITOR:

1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=48> [14:50:00T]
[SOB]"=@=@=@=>7È=@!~~~~~~~~!~~~~~~~~[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=63> [14:50:01T]
[SOB]Ý=@=@´ =@NF4RC~~~~CQCQCQ~~~xÚ3ðÏÊÉÌKUÐpÑ
r Ò=@*Œ³[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=48> [14:51:01R]
[SOB]"=@=@=@=>7È=@!~~~~~~~~!~~~~~~~~[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=63> [14:51:03R]
[SOB]Ý=@=@=>À=@NF4AC~~~~KX4Z~~~~xÚpvËÌIõÉ,.ñÊO'=@)¿:[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=48> [14:51:08R]
[SOB]"=@=@=@=>7È=@!~~~~~~~~!~~~~~~~~[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=49> [14:51:10R]

30

[SOB]Ý=@µ¬=@KX4Z~~~~NF4AC~~~xÚ=@=@=@=@[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=48> [14:51:22R]
[SOB]"=@=@=@=>7È=@!~~~~~~~~!~~~~~~~~[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=58> [14:51:24R]
[SOB]Ý=@=@=@SÄ=@NF4AC~~~KX4Z~~~~xÚc (J-6Ô+©(=@t^[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=48> [14:51:28R]
[SOB]"=@=@=@=>7È=@!~~~~~~~~!~~~~~~~~[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=52> [14:51:30R]
[SOB]Ý=@=@=@úf=@KX4Z~~~~NF4AC~~~xÚca=@=@=@ [EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=48> [14:51:45R]
[SOB]"=@=@=@=>7È=@!~~~~~~~~!~~~~~~~~[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=58> [14:51:47R]
[SOB]Ý=@=@=@SÄ=@NF4AC~~~KX4Z~~~~xÚc (J-6Ô+©(=@t^[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=48> [14:51:51R]
[SOB]"=@=@=@=>7È=@!~~~~~~~~!~~~~~~~~[EOB]
1:Fm SRC To CQ Via RELAY <I R F R1 S7 Pid=F0 Len=52> [14:51:53R]
[SOB]Ý=@=@=@úf=@KX4Z~~~~NF4AC~~~xÚca=@=@=@ [EOB]

https://ecfsapi.fcc.gov/file/10042734814100/InconvenientCorrections.pdf

Claim that distance insurmountable

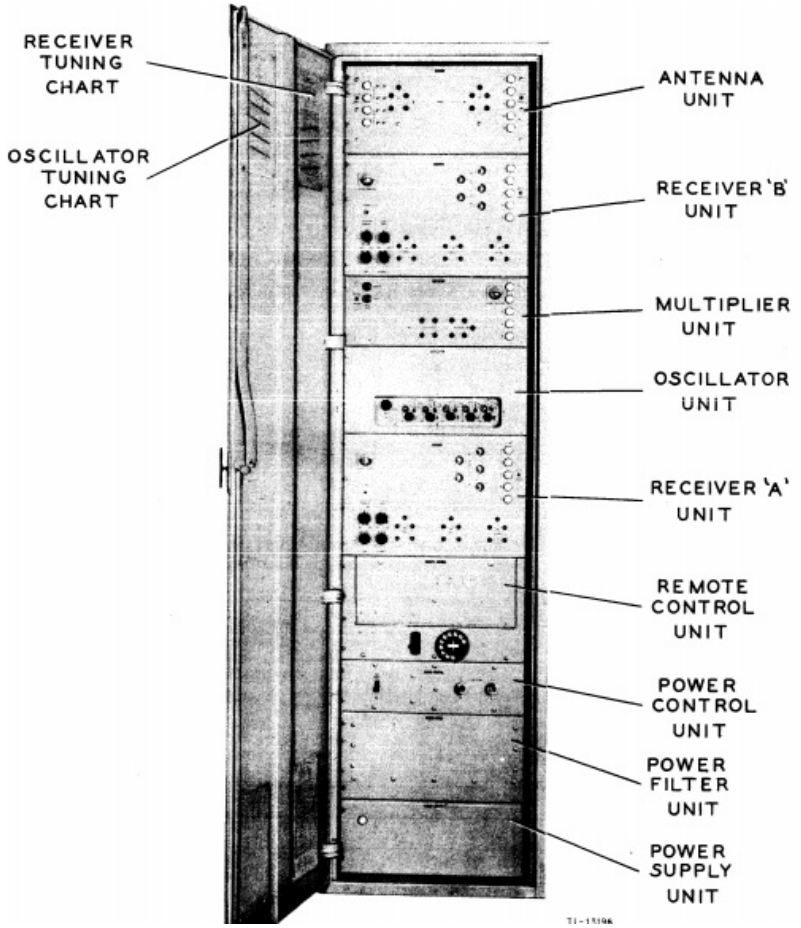
- HF fading etc said to make impossible monitoring.
- Completely unwilling to consider diversity receiving
- 900 mile experiment conceived to test this issue

Bus-Stop Experiment

Big Success

- Multiple successful captures and decodes of messages being passed by two OTHER stations
- Flip-Flop: home station and bus-stop station reversed roles on different days (confounding the claims of later “expert” critic)
- Almost got a HUGE message thru....
- Analysis of packets from that attempt first verification of power of DIVERSITY RECEPTION
- REF: https://ecfsapi.fcc.gov/file/109191626613689/Inconvenient Truths.pdf

Diversity



Diversity systems known since 1920's. World War II Diversity receiving system.

Easy to do now with web-based SDR's.

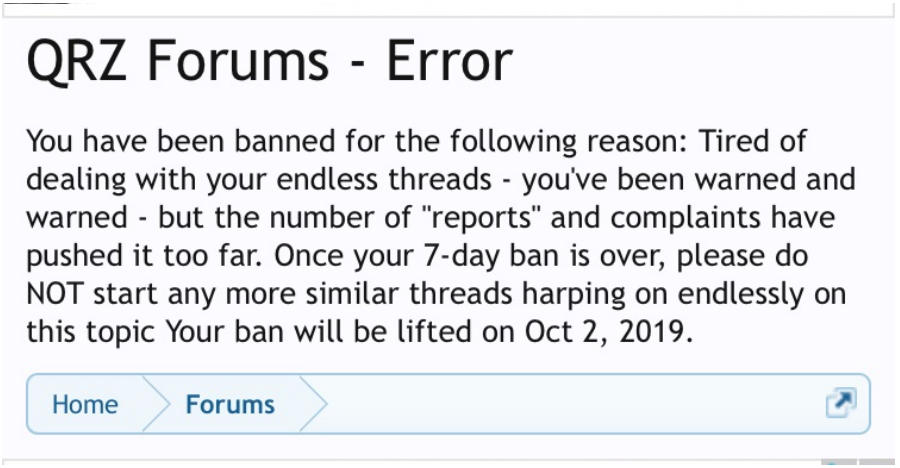
Even found it in papers with Rappaport's name on them.

Analysis of Lincolns Gettysburg

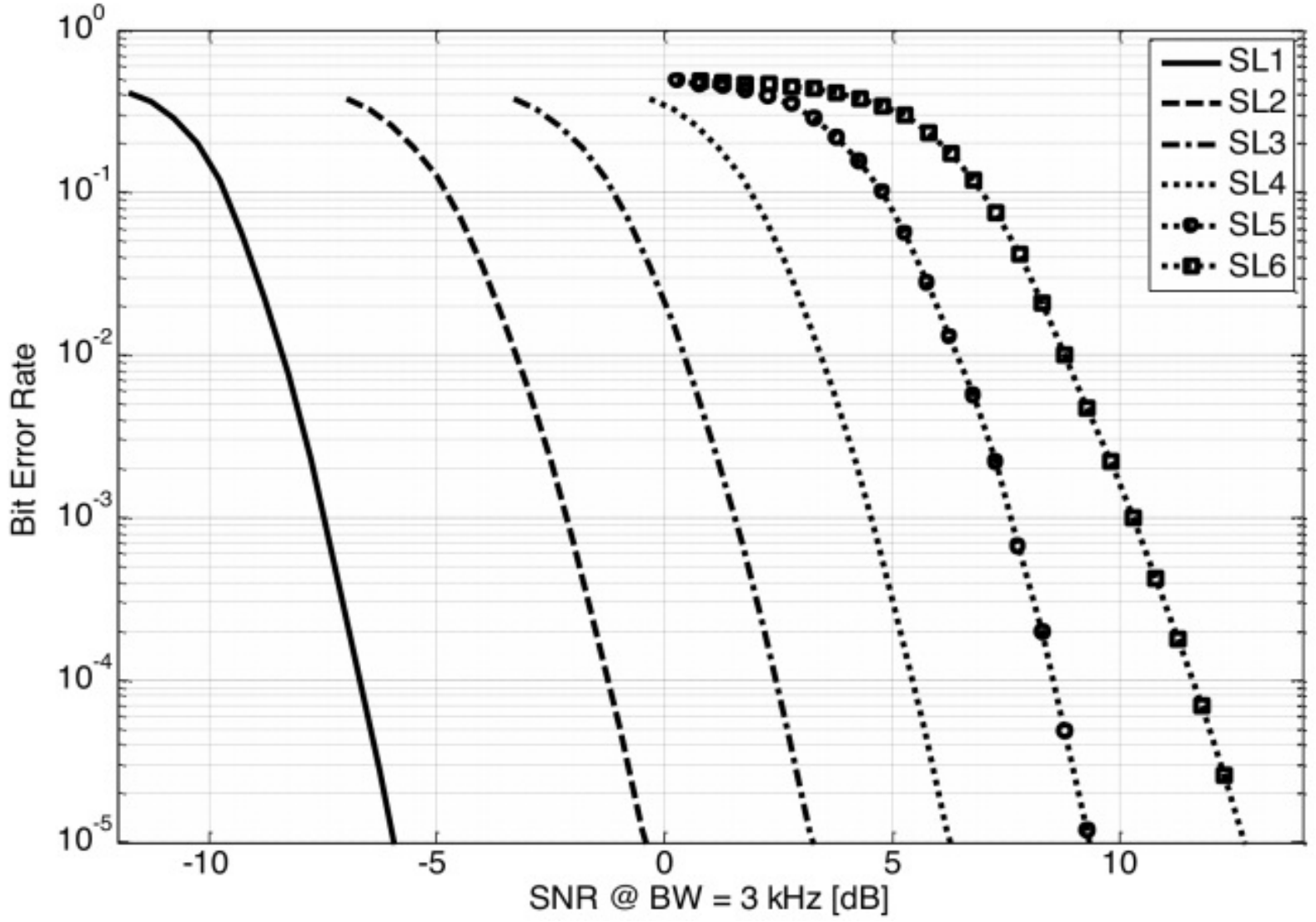
- What the monitoring station missed.... the intended station got.
- What the intended station had to request a repeat....the monitoring station had gotten...
- PHASE DIFFERENCE in fading between the two locations miles apart
- Proved the benefit of diversity receiving.
- Possible with SDR's.
- Pooh-pooh'd by the detractors.

Rappaport Again

- Petition for declaratory ruling that in effect, winlink is illegal.
- 16-239 resurrected.
-
-
-
- Moderator interference
- Eventual permanent banning for “vehemence”



Pactor Speed Levels

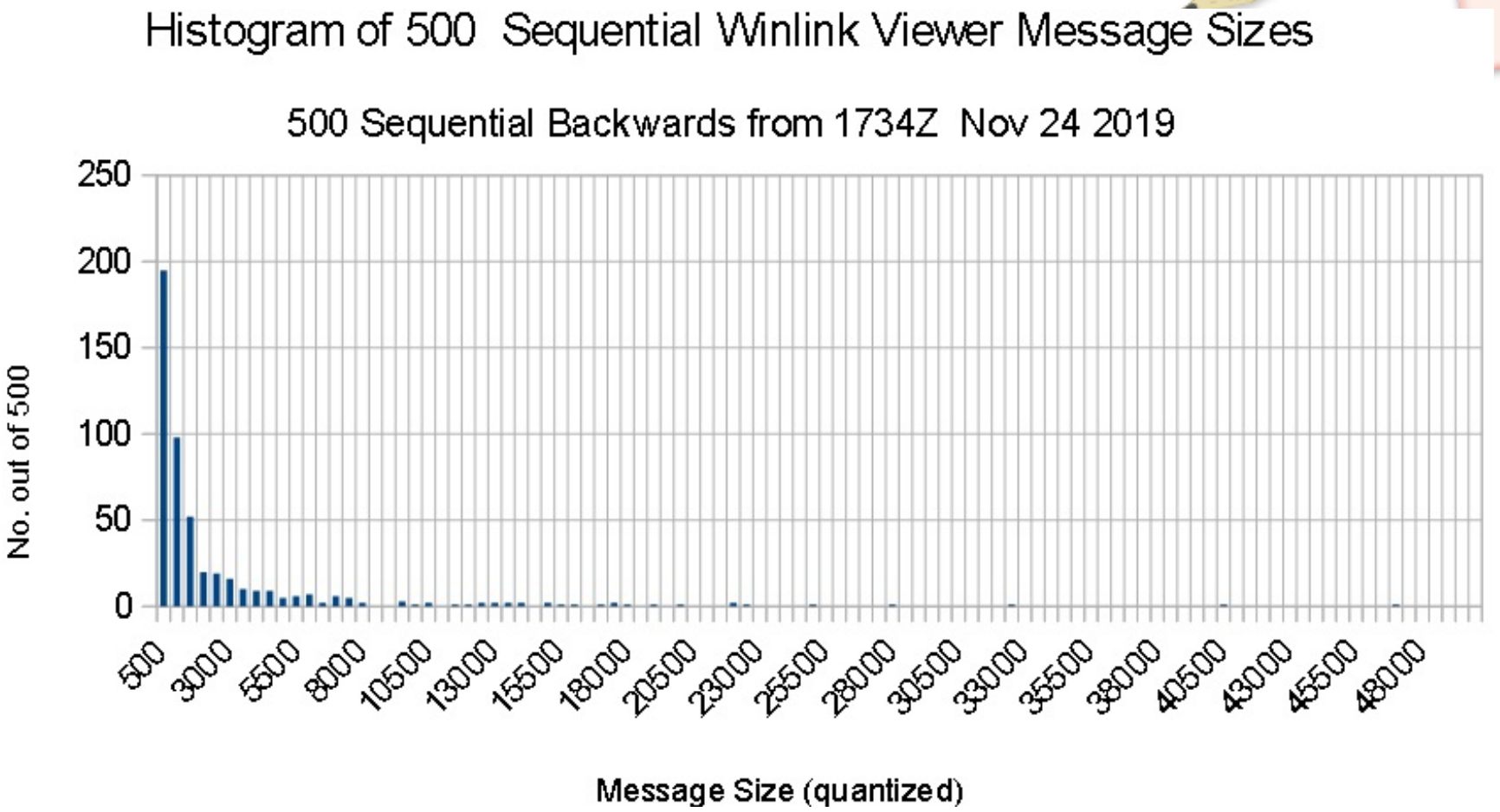


Detractors generally don't grasp the implications of this performance....

Raspberry Pi Pactor!

- Raspberry pi-based Pactor 3 reader released.
- WORKS!
- Even includes auto-decompressing of WINLINK messages
-

pi@raspberrypi: ~
Inbox (722) - docvacu...
pi@raspberrypi: ~
File Edit Tabs Help
###INPUT AMPLITUDE: 24.2 % of possible maximum
###INPUT AMPLITUDE: 24.9 % of possible maximum
###INPUT AMPLITUDE: 25.0 % of possible maximum
###INPUT AMPLITUDE: 23.0 % of possible maximum
^Cpi@raspberrypi:~ $ pmon -a hw:1,0
Welcome to PMON (Linux)
The PACTOR(R) Monitoring Utility
Version 0.9-3
(C) Copyright 2019 SCS GmbH & Co. KG, Hanau, GERMANY
*** FOR PRIVATE USE ONLY! ***
Please read the license: pmon --license
INFO: could not find a config file! Using defaults.
PACTOR-1/2/3 Monitor started:
8F,DA,01,F1,C2,C1,B9,DE,5E,F1,77,74,EC,2B,A8,F0,28,D5,AF,A7,5A,5B,5B,4E,97,FB,F7,F9,A7,53,BF,8B,E0
EE,43,F0,A2,F7,81,59,CE,00,CD,50,D9,3E,F7,5B,FF,F9,9F,37,B0,3E,BF,8D,D3,F7,F2
Canarit
www.CANARIT.com



Disproved the claim that I was reading insignificantly sized messages.

Prime Detractors

- Ron Kolarik -- changing positions
- Ted Rappaport - inexplicable
- “wireless girl” - scattershot of criticisms
- Lee McVey -- often seemed confused
- Sollenberger (got drawn in this)
- QRZ Administrator.

“Band Planning Comments”

- Generally resistant to ANY request for documentation.
- After two decades still cannot provide apparently ANY callsigns, dates, frequencies of supposed “interference”
- Greatly hinders doing anything to understand their concerns.
- General lack of understanding of 97.221(b)(c) and foreign stations.

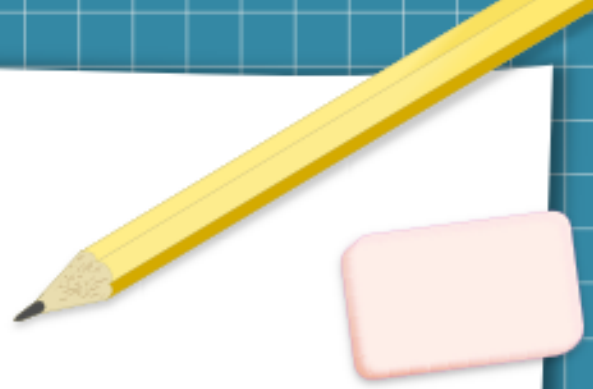
Friends I gained

- Peter Helfert - DL6MAA -- brilliant designer
- Lor Kutchins -- wise, kindly
- Steve Waterman -- mission minded
- Tom N5TW -- fantastic hall monitor who got folks in line quickly
- Many others! ARRL Attorney has been right on point continuously.

Just the Facts

- Winlink uses protocols developed 30 years ago by volunteer ham Jean-Paul Roubelat.
- Thoroughly legal.
- PACTOR is proprietary - but so is one of the modes explicitly legal by FCC - not questioned ever in any other nation
- WINLINK can be easily decoded if good enough signal.
- Good enough signal may require diversity or SDR
- There is no encryption except in the minds of some diehards.

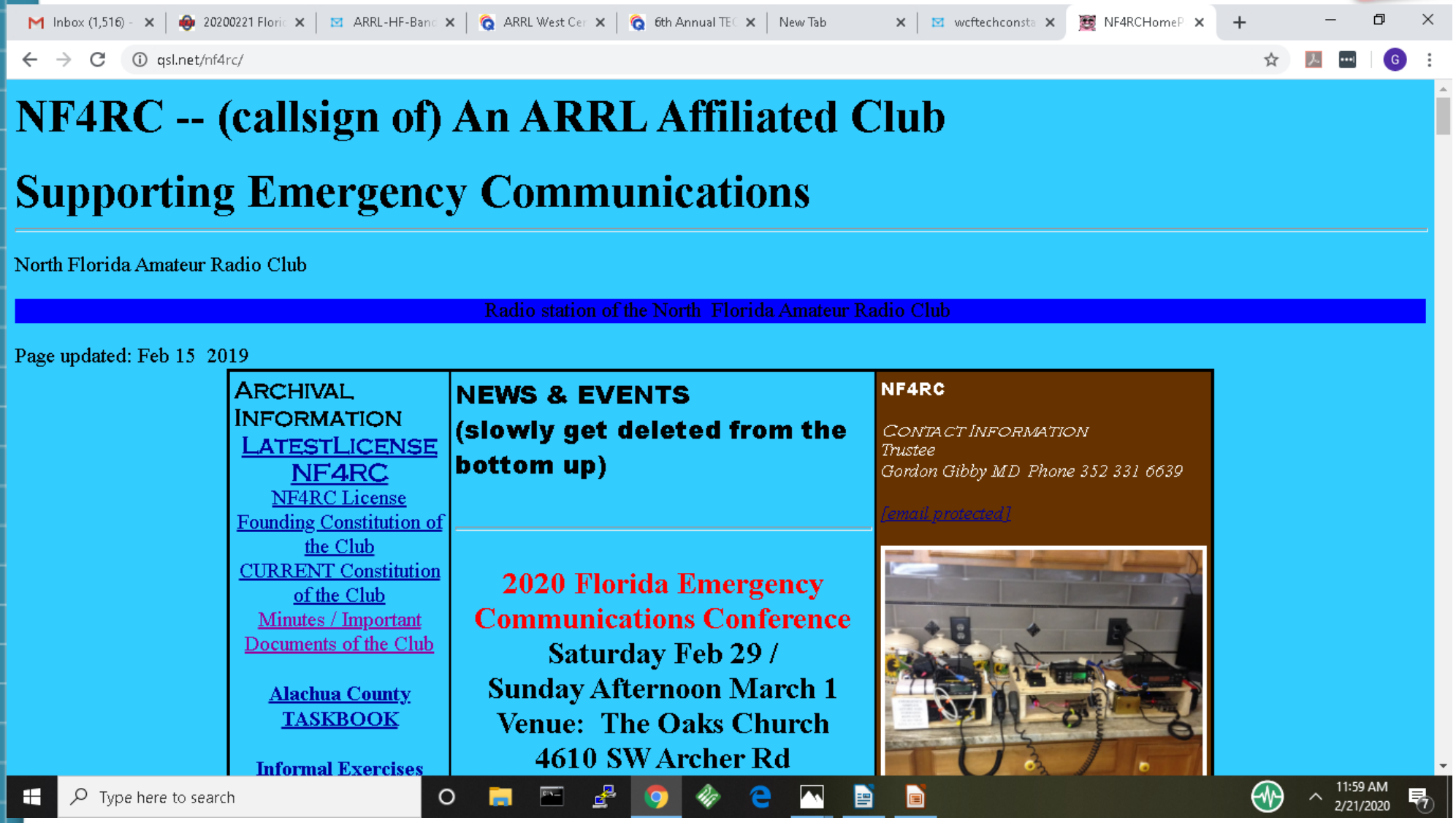
QUESTIONS?



Plug for 2020 Conference

- EC-001 Course (Friday/Monday)
- Lectures & Hands-On Saturday
- Deployment Exercise Sunday Afternoon
- Homeland Security Exercise Evaluation Progra
- BASIC & LEADERSHIP Tracks
- Get your TASKBOOKS signed.....
- Go home to lead your group

qsl.net/nf4rc



FCC Filings 400 pages 500 footnotes

- 11831-1
  https://ecfsapi.fcc.gov/file/10406909918891/FCCRM11831-1.pdf
- 11831-2 (97.221(c) zero interference)
  https://ecfsapi.fcc.gov/file/10408063816674/FCCRM11831-2.pdf
- 11831-3
  https://ecfsapi.fcc.gov/file/10410123566989/FCCRM11831-3.pdf
- 11831-4 (Spoofing Experiment)
  https://ecfsapi.fcc.gov/file/10410170249078/FCCRM11831-4.pdf

- Repeat Spoof & Explanations
  https://ecfsapi.fcc.gov/file/1071540521688/FCCCommentJuly2019.pdf

- https://ecfsapi.fcc.gov/file/1071540521688/FCCCommentJuly2019.pdf
- First Incidence Calculations:
  - https://ecfsapi.fcc.gov/file/1072323040342 1/IncidenceCalculations.pdf

- Successive improvement
  https://ecfsapi.fcc.gov/file/107301549501394/IncidenceCalculationsExParte0730.pdf
- Response to Rappaport
  https://ecfsapi.fcc.gov/file/10730701023399/ResponseToRappaportJuly24Filing.pdf
- Little interest in surveillance
  https://ecfsapi.fcc.gov/file/1080509964054/ExParteCommunicationAug5.pdf
- Explanation of historical decompression
  https://ecfsapi.fcc.gov/file/1080859781798 2/ExParteCommunicationAug8.pdf

- Further reduction in objectionables
  https://ecfsapi.fcc.gov/file/10822196770221/ReAnalysisOfWinlinkObjectionableMessages.pdf
- Announcement of free software
  https://ecfsapi.fcc.gov/file/10830048730238/FreeSoftwareToReadWINLINK.pdf
- Myths
  https://ecfsapi.fcc.gov/file/10906223525884/ExParteMyths.pdf
- 900 mile tests
  https://ecfsapi.fcc.gov/file/10919162661368 9/InconvenientTruths.pdf

- D-RATS and other systems
  https://ecfsapi.fcc.gov/file/10042734814100/InconvenientCorrections.pdf
- Not missing the Forest
  https://ecfsapi.fcc.gov/file/101705888999/NotMissingTheForest.pdf
- Inconvenient Observation
  https://ecfsapi.fcc.gov/file/1031895715302/InconvenientObservations.pdf
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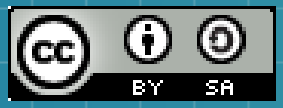

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